Community Relations Office

September 11, 2000

Ms. Trisha Pritikin
439 Boyton Avenue
Berkeley, CA 94707

Dear Ms. Pritikin:

Berkeley Lab has prepared responses to the many questions you submitted at the April 25, 2000, Environmental Sampling Project Task Force meeting. This document is enclosed for your use. Both your questions and the Lab's responses will be posted to the taskforce website, and will also be submitted to other websites for posting, including the PTA websites for nearby schools, and the Lawrence Hall of Science website.

Thank you for your careful assembly of these questions from the parents in your neighborhood and school.

Sincerely,

Terry Powell
Community Relations Coordinator

Ernest Orlando Lawrence Berkeley National Laboratory
One Cyclotron Road, MS 50A-4119 Berkeley, CA 94720
Tel: 510-486-4387 Fax: 510-486-4553 Email: tpowell@lbl.gov

PARENTS CONCERNS: SAFETY OF FIELD TRIPS TO LHS

I. Exactly what does tritium do to the body when it comes in contact with humans?

a. to infants and children, people with immune system problems.

b. when emitted from the stack

c. when bound with water (rainwater) or with fog

2. Do the leaves from the eucalypti and other plants around the LHS retain H3? What happens when kids walk around in the leaves, pick up leaves, make necklaces out of the seed pods of eucalypti (which is a favorite thing to do with eucalyptus pods)

3. What about the safety of the Strawberry Canyon (for hiking, etc)

4. Tritium in the local water supply and in swimming pools, lakes, etc

5. Which way is H3 dispersed in the air? That is, which way does the wind blow? Do the hills cause the tritium to disperse in something of a “hot spot”?

6. Are there times of day or times of year when exposures are higher from the NTLF?

7. What happens to people who have higher radiosensitivity, compromised immune systems, pregnant women, infants- the more vulnerable groups,, when exposed to these emissions?

8. Why hasnt LHS put any information on these releases in their LHS brochures?

PAST RELEASES

I. How do we know when and how much H3 was released from past projects at the NTLF? From the time it started operating.

2. What effort is being made to track people who may have been exposed to higher releases?

3. Have any health surveys of those exposed to significant releases in the past been carried out?

THE ACCELERATOR AT THE LAB

I. What sort of radiation levels have been produced which traveled into the neighborhoods surrounding the accelerator?

2. What would the health implications of levels be?

3. Are there “safe” exposure levels associated with these rad releases from the accelerator? Why should we as parents accept these levels when many of us want NO exposures?

4. Is there not neutron bombardment of neighborhoods surrounding the accelerator? Why werent people in the neighborhoods told of this?

Note that these are not yet in any kind of order:

I. Where is the PROOF that visiting LHS, or living near the NTLF is safe???

2. How long has this been going on and why weren't we told earlier?

3. How long does it take for the tritium to make people sick?

4. Why cant they just move the tritium labelling facility so it isnt sending stuff out the stack onto kids?

5. Why cant the lab have meetings about all of this with the schools

6. I grew up here- if I was exposed to tritium, might i have passed something on to my kids?

7. Why havent any health surveys been done of the neighborhoods where the tritium may have gone- and where DID it go exactly?

8. lsnt the fog a means by which the tritium can bind and become even more deadly to humans? NTLF is in a fog belt.

9. lsnt there an earthquake fault running right near the NTLF?

10. Could the tritium releases be one of the reasons that the SF Bay Area has the highest rate in the country of breast cancer?

11. What else is released into the air or water from the tritium labelling facility? Is it just tritium or tritium byproducts, or what?

12. Why hasnt the lab done surveys of people who have lived in the tritium “downwind” regions over the past years to see if they have any health problems which may show patterns??

13. Have citizens, particularly parents, been involved in advising the sampling plans?

14. Most of us, as parents, OUTSIDE Berkeley, but whose kids frequent the LHS, havent been involved before in all of this- how can we become involved?

15. Can you advertise meetings ahead of time?

16. WHY should we parents have to accept regulatory exposure standards? What if we dont want our children exposed at all?

SAFETY OF FIELD TRIPS TO LAWRENCE HALL OF SCIENCE
T. Pritikin Questions, April 25, 2000 Environmental Sampling Task Force meeting
Lawrence Berkeley National Laboratory Responses

GENERAL

1. Exactly what does tritium do to the body when it comes in contact with humans?
a. To infants and children, people with immune system problems.

The radiation emitted by tritium cannot penetrate clothing or skin, and travels only about five millimeters (two-tenths of an inch) through the air. Tritium can only be taken into the body through breathing, eating, or skin contact. Once inside the body, tritium as tritiated water (HTO) diffuses freely and rapidly, spreading evenly throughout the body. The International Commission on Radiological Protection (ICRP) recommends that tritium should be considered, for radiation protection purposes, to be uniformly distributed in the body. Consequently, radiation doses after tritium exposures are homogeneously distributed throughout the body. Tritium leaves the body in the same time and manner as body water is eliminated from the body.

Tritium metabolism is marginally affected by differences in age, gender, and health conditions (e.g., immune disorders). Tritium elimination is generally faster in children and decreases with age. For a given intake of tritium from inhalation, ingestion, or skin absorption, doses for adults and children can be estimated from dose coefficients published by the ICRP. The estimated risk from the National Tritium Labelling Facility (NTLF) tritium releases, for adults and children from a typical one-time visit to the Lawrence Hall of Science (LHS), is very small (small fractions of a chance in one million). At these low levels, the risk is indistinguishable from zero.

b. When emitted from the stack?

Small amounts of tritium are released from Berkeley Lab's NTLF as tritiated water vapor (HTO) and as tritium gas (HT). The primary route for human exposures to tritium from the NTLF is through the air pathway, after release from the stack. Once inhaled or absorbed through the skin, the tritiated water vapor (HTO) diffuses freely and rapidly inside the body.

c. When bound with water (rainwater) or with fog?

The presence of rain or fog will more than likely reduce the dose from tritium. This is because the dose from the intake of tritiated water vapor is proportional to the concentration of tritium in atmospheric water. Tritiated water vapor (HTO) exchanges readily with water (H_2O) in rain or fog. If rain or fog occurs, the amount of water vapor in the air is at a maximum. For the same amount of tritium release, the tritiated water concentration in air during the time that rain and fog are present will be lower than when rain and fog are absent (given similar conditions of wind speed and atmospheric stability). Therefore, dilution of tritiated water vapor by the presence of rain or fog will

reduce the dose. The presence or absence of rain or fog is of academic significance, however, due to the extremely small amounts of tritium emitted from the National Tritium Labeling Facility.

2. Do the leaves from the eucalypti and other plants around the LHS retain H3? What happens when kids walk around in the leaves, pick up leaves, make necklaces out of the seedpods of eucalypti (which is a favorite thing to do with eucalyptus pods)?

Yes, tritium is retained in leaves as tritiated water (HTO) for relatively short periods of time and as organically bound tritium (OBT) for longer periods of time. Tritium, as tritiated water vapor, enters the plant very quickly when air containing tritium is blowing across the plant, and it exits just as quickly (within 15 minutes to 2 hours) if the wind blowing over the plants contains no tritium. A small amount of tritiated water is converted to OBT in the leaves. Measurable levels of HTO and OBT in leaves are limited to an area within 200 meters of the stack. However, the beta energy of tritium is too low to penetrate the skin if a child were to handle the leaves or make necklaces out of the seedpods. In addition, the amount of HTO that could be absorbed through the skin or inhaled from handling leaves would be far below detectable levels. As stated in the response to Question 1b above, the primary route of exposure is the direct inhalation and skin absorption of HTO in air. Compared to this route of exposure, the potential for incidental exposure from handling leaves containing HTO and OBT would be negligible.

3. What about the safety of Strawberry Canyon (for hiking, etc)?

The risk from exposure to tritium that has been dispersed in Strawberry Canyon is very low, far below regulatory levels of concern and far below levels that would be considered of concern for the protection of public health. The measurements of tritium in vegetation, air, surface water, and soil in Strawberry Canyon are either below or very near the limits of detection.

4. Tritium in the local water supply and in swimming pools, lakes, etc.

The Berkeley Lab monitors the tritium levels in creeks around its site. The tritium levels measured at these locations are usually below detection limits, but for those that are measurable, they are far below the EPA drinking water standard. The issue of children wading or swimming in local pools has been considered in the LBNL risk assessment of the NTLF that was published in 1997.

In addition, surface or groundwater in the area of the Laboratory is not used as a drinking water source. The local water supply source is from Sierra Nevada snowmelt, provided by the East Bay Municipal Utility District.

Berkeley Lab also monitors tritium in nearby lakes. In past years, samples taken at Lake Anza and Lake Temescal were both below the detection limit for tritium. All surface water samples are reported in the annual site environmental reports issued by Berkeley

Lab, which are available at the UCB Doe Library or via internet at: http://www.lbl.gov/ehs/epg/html/env_protection.htm.

5. Which way is H3 dispersed in the air? That is, which way does the wind blow? Do the hills cause the tritium to disperse in something of a "hot spot"?

Concentrations of tritium in air decrease with distance from the source. This rate of decrease in tritium concentrations is most affected by wind speed and turbulence from unstable atmospheric conditions and obstacles such as trees and buildings. Wind direction plays the most important role in determining which way tritium is dispersed in air.

For many years, meteorological information collected continuously at the Lab in the vicinity of the NTLF hillside has revealed consistent wind direction patterns when studied either daily, seasonally, or annually. The two predominant wind directions are west/northwesterly and southeasterly. Southeasterly winds blow toward the Lawrence Hall of Science (LHS). Upon closer look, southeasterly winds most commonly exist during nighttime hours or in association with storm systems passing through the region. While winds towards LHS are possible during daytime hours, the frequency of this occurring is low. For example, on an annual basis, winds blow away from the direction of LHS about 85% of the NTLF operational hours. Continuous ambient air monitoring east of the hillside stack and at LHS confirms that prevailing winds do not favor tritium being transported over the fence to LHS.

Hills such as the one between LHS and Berkeley Lab affect wind flow patterns but none of our data indicate any "hot spots" of concentrations. In fact, the Lab has recently sited a portable meteorological station in the hillside eucalyptus grove. The distribution pattern of the wind direction between the two nearby meteorological monitoring locations is very similar, although there is a minor shift (i.e., about 25 degrees) in the predominant wind direction. This shift is due to the influence of the hillside. Berkeley Lab recently began using an atmospheric dispersion model (CALPUFF) that is capable of accounting for features such as terrain, buildings, and vegetation when determining concentrations at a specified location. The results of the CALPUFF analyses will be used to identify potential "hotspots," if any exist, although no such conditions are anticipated to occur.

6. Are there times of day or times of year when exposures are higher from the NTLF?

There is no evidence at this time to suggest that any individual residing beyond the site boundary of Berkeley Lab has approached or exceeded the 10 mrem per year EPA regulatory limit, even during the times of the day when the highest releases of tritium are taken into account. This conclusion is based on both our most recent application of the CALPUFF model, with its consideration of complex terrain and the discontinuous nature of releases, and the use of ambient environmental measurements, including limited bioassay (urinalysis) measurements of individuals on- and offsite. Additional conservatism in dose estimates is obtained through Berkeley Lab's use of the conservative assumption of adding releases of tritium gas (HT) to releases of tritiated

water vapor (HTO) and treating the sum as 100% HTO. In the environment, an exposure to HT produces doses that are 10,000 times lower than a similar exposure to HTO.

Berkeley Lab has used the CALPUFF model to evaluate maximum and average exposures to visitors at LHS for tritium release periods ranging from 15 minutes to several hours, including multiple visits. More detailed information on the results of this analysis was presented at the August 10, 2000 Environmental Sampling Project Task Force meeting in Berkeley, and is posted to the Task Force website at http://www.lbl.gov/ehs/tritium/. See Dr. Hoffman's presentation and attached tables. A paper documenting these results is currently in preparation for distribution at the next Task Force meeting.

7. What happens to people who have higher radiosensitivity, compromised immune systems, pregnant women, infants- the more vulnerable groups, when exposed to these emissions?

There are slightly elevated radiation risks for people who have higher radiosensitivity, compromised immune systems, pregnant women and infants. However, radiation protection standards are developed and designed to offer adequate assurance of protection to the most radiosensitive members of the populations. For the purposes of protection of public health, regulators assume that there is no exposure level that is completely free of risk, but standards are set to ensure that actual risks to real persons from exposures to radiation will be small. All radiation protection standards used for the protection of public health are established with full stakeholder involvement.

The mechanism of energy deposition of tritium is somewhat comparable with the much more extensively studied x-rays and gamma rays. At present, regulatory bodies in the U.S. and abroad do not give credit for any differences. At LBNL, risk assessments have accounted for the fact that the relative biological effectiveness of tritium beta energy may be as much as 1 to 5 times larger than the effect of a similar absorbed energy from x-rays and gamma rays. Even with these assumptions, the assessment of the excess lifetime cancer incidence risk from exposure to short-term for visitors to the Lawrence Hall of Science has been found to be very small. These risks are fractions of one chance in million, a risk that is so small as to be indistinguishable from zero. For most situations, the excess risk is zero because the wind mostly is not blowing from the Building 75 hillside stack during daytime hours. Again, see Dr. Hoffman's presentation and attached tables.

8. Why hasn't LHS put any information on these releases in their LHS brochures?

The LHS website includes information on Berkeley Lab's tritium releases from the NTLF and may be viewed at http://www.lhs.berkeley.edu. Search for *tritium* at this website.

The Berkeley Lab has responsibility for public information about its National Tritium Labelling Facility and associated tritium emissions. The Berkeley Lab coordinates the distribution of pertinent information with its neighbor, the Lawrence Hall of Science.

PAST RELEASES

1. How do we know when and how much H-3 was released from past projects at the NTLF? From the time it started operating.

Annual releases of tritium from Berkeley Lab are published in the Lab's annual Site Environmental Reports. In recent years, the information is available from the Lab's web-site, at http://www.lbl.gov/ehs/epg/html/env_protection.htm and is also available to read at the UC Berkeley main library, Doe Library, second floor.

2. What effort is being made to track people who may have been exposed to higher releases?

In order to detect the effect of radiation exposure in a very large population of exposed persons, the total dose must reach levels of about 10,000 mrem. Below these levels, even for very large numbers of individuals, it is extremely difficult, if not impossible, to determine an effect using epidemiological investigations. The doses received by those residing near Berkeley Lab from either past or present releases of tritium from the NTLF are a fraction of a percent of these levels. Thus, there is no evidence that members of the public have been exposed to levels of releases that would indicate the need for medical tracking over time. In 1999, the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR) examined issues associated with a petition that included tritium releases from Berkeley Lab, possible cancer clusters, infertility issues in the neighborhoods surrounding the facility, and drinking water issues associated with the Summit Reservoir approximately 1-2 miles away. The ASTDR report concluded that there was "no apparent indication that the health of nearby residents is at risk from radiological releases from the Lawrence Berkeley National Laboratory and the National Tritium Labeling Facility." This report is available via the web at http://www.lbl.gov/LBL-Programs/tritium/index.html.

3. Have any health surveys of those exposed to significant releases in the past been carried out?

See response to Question 2 above. The entire 1999 ATSDR report is available for review at http://www.lbl.gov/LBL-Programs/tritium/index.html. In addition, the Laboratory prepared a tritium risk assessment in 1997, which is available via the web at: http://www.lbl.gov/ehs/epg/tritium/.

THE ACCELERATOR AT THE LAB

1. What sorts of radiation levels have been produced which traveled into the neighborhoods surrounding the accelerator?

Presently radiation-producing machines (e.g., accelerators, x-ray machines, and irradiators), are used at Berkeley Lab for radiation research. Accelerators in use at the

Berkeley Lab have produced radiation fields in their immediate surrounding areas, and to a lesser extent at more distant locations. The radiation fields created by high-energy accelerators consist predominately of neutron radiation, not unlike the cosmic radiation fields present in high-altitude aircraft or on mountaintops. Environmental monitoring stations have been established at strategic locations near the site boundary to monitor the levels of these radiation fields. The monitoring stations are located so as to measure the highest accelerator-produced radiation levels that may occur at the site boundary. Radiation levels at more distant locations, such as nearby neighborhoods, will be lower than these measured at the monitoring stations. The 1999 Site Environmental Report shows the annual dose at the site perimeter is less than 1 mrem/year.

Exposures were higher in the past. Peak radiation levels at the Olympus Gate monitoring station were reported for the years 1959 and 1960 at approximately 820 and 650 mrem per year, respectively. This was due to operation of the accelerator known as the Bevatron, which ceased operations in 1993. The radiation levels were reduced in subsequent years and have remained below 100 mrem per year since 1970. A recent re-evaluation of the 1959 and 1960 monitoring data has shown that the radiation levels reported in earlier years were evaluated by very conservative techniques, and would have been reported as lower by more than half using modern-day evaluation procedures, i.e., well below 500 mrem per year every year.

2. What would the health implications of levels be?

The detection of radiation effects, even in a very large population of exposed individuals (many tens of thousands of individuals), is very difficult, if not impossible, when the total dose received by these individuals is lower than about 10,000 mrem.

3. Are there "safe" exposure levels associated with these rad releases from the accelerator? Why should we as parents accept these levels when many of us want NO exposures?

We accept the premise that there is no exposure to radiation that is entirely risk-free. Nevertheless, it is very difficult to detect the presence of excess risk in a large population of exposed individuals when exposures are much less than 10,000 mrem.

The current regulatory standard for radiation fields in uncontrolled areas is 100 mrem per year. That same standard was 1,500 mrem in the 1950's, and has been reduced over the years as knowledge of radiation effects and criteria for protection of the public have changed. In 1958 the Atomic Energy Commission adopted the recommendations of the National Council on Radiation Protection and Measurements (NCRP) that the permissible radiation exposure limit for uncontrolled areas be reduced from 1500 mrem per year to 500 mrem per year, and that existing facilities should take measures to ensure meeting the new limit within a five-year time period. Such measures were taken at the Bevatron by designing and adding roof shielding which reduced the levels of neutron radiation measured at the Olympus Gate environmental monitoring station. At no time did the

radiation levels measured at the site boundary exceed the then-current recommendations of the NCRP.

The criterion of "no exposure" is not achievable in light of the radiation exposure we all receive from natural background radiation, medical sources, and various consumer products. Regulatory standards set maximum permissible exposure levels above background radiation for protection of workers and the public. The regulatory standards are developed through well-defined processes. Results of published scientific research studies, which may be conflicting, are reviewed by expert panels such as the National Academy of Sciences, to arrive at a scientific consensus of radiation risks. The consensus findings are further reviewed by advisory bodies such as the NCRP in order to arrive at recommendations for radiation protection policies. Finally, regulatory bodies such as the US EPA, NRC, and DOE act on the findings and recommendations to formulate proposed regulations that are published for public comment prior to being finalized as regulatory requirements. Thus all radiation protection standards used for the protection of public health are established with the opportunity for public involvement.

4. Is there not neutron bombardment of neighborhoods surrounding the accelerator? Why weren't people in the neighborhoods told of this?

The radiation fields from the Bevatron, closed since 1993, consisted predominantly of neutron radiation. The levels of neutron radiation reaching the site perimeter were within the then-current federal standards for radiation levels in uncontrolled areas. The total radiation dose equivalent was monitored and reported to the public in routine environmental monitoring reports, scientific articles and books that were published by Berkeley Lab. For a summary of early accelerator operations at Berkeley Lab request a copy of Research/Accelerators, Pub 300 volume 3, number 6, November/December 1978, available from the Berkeley Lab Community Relations office. Recent environmental monitoring reports are available online, at http://www.lbl.gov/ehs/epg/html/env_protection.htm, or in hard copy at the UC Berkeley main library, Doe Library, second floor.

OTHER QUESTIONS

1. Where is the PROOF that visiting LHS, or living near the NTLF is safe?

In 1997, Berkeley Lab released to the public the results of a peer- and regulator-reviewed health risk assessment conducted for its National Tritium Labelling Facility. The assessment showed that people who work at the Lab, as well as those on the UC Berkeley campus or who live in surrounding neighborhoods, incur a very small increased risk of cancer as a result of the facility's operations. These are far below levels of regulatory concern, or concern for the safety of the public. These small risk levels are far below risks that are detectable using epidemiological investigations. In fact, the maximum risk to a maximally exposed hypothetical individual downwind of the Building 75 hillside stack is so small as to be indistinguishable from zero. The report, "Environmental Health Risk Assessment for Tritium Releases at the National Tritium Labelling Facility at the

Lawrence Berkeley National Laboratory" is available for review at http://www.lbl.gov/ehs/epg/tritium/ and the UC Berkeley main library, Doe Library, second floor.

In 1999, the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR) examined health concerns that may pertain to tritium releases from the NTLF. The ATSDR report concluded that there was "no apparent indication that the health of nearby residents is at risk from radiological releases from the Lawrence Berkeley National Laboratory and the National Tritium Labelling Facility." The entire ATSDR report is available for review at http://www.lbl.gov/LBL-Programs/tritium/index.html or the UC Berkeley main library, Doe Library, second floor.

More recently, an IFEU report by Franke and Greenhouse, on "Review of Radiological Monitoring at LBNL," has explicitly stated that there is no evidence that people, either workers or members of the public, have been exposed to higher levels of releases from the NTLF that would suggest that residing near the facility is unsafe. This IFEU report was done through a contract with the City of Berkeley, and is also available at http://www.lbl.gov/ehs/tritium/ or the UC Berkeley main library, Doe Library, second floor.

2. How long has this been going on and why weren't we told earlier?

Established in 1982, the NTLF at Berkeley Lab has been a pioneering place to work where biomedical researchers come and design the creation of tritium-labeled compounds, often using brand new labeling techniques. Annual releases of tritium from Berkeley Lab have been published regularly in the Lab's Site Environmental Reports. These are available from the Lab's website, at http://www.lbl.gov/ehs/epg/html/env_protection.htm. These are also available to read at the UC Berkeley main library, Doe Library, second floor

3. How long does it take for the tritium to make people sick?

The Berkeley Lab does not believe that the low levels of tritium released from the NTLF makes people sick. Tritium is considered to be a low-hazard radioisotope. The biological changes from tritium exposures are somewhat comparable to the much more extensively studied x-rays and gamma rays such as those routinely used in medical diagnostics. At levels of exposure to tritium consistent with those associated with Berkeley Lab operations, any effects would be below the limits of epidemiological detection and would be indistinguishable from zero.

4. Why can't they just move the tritium labeling facility so it isn't sending stuff out the stack onto kids?

The Berkeley Lab does not agree that it is appropriate to move NTLF operations somewhere else. The NTLF is conducting research in the national interest and is performing well within applicable limits to maintain environmental quality and public health. Tritium-labeled compounds produced at the NTLF have been used to better

understand the cause of many diseases including various cancers, Alzheimer's, and viral infections. This facility is unique in the United States because it provides researchers with state-of-the-art technologies and advanced methodologies to do labeling and to do the analysis of biomedical compounds at the same location.

The NTLF was established at the Berkeley Lab as a National Institutes of Health national resource center, and is a world leader in providing tritium-labeled pharmaceuticals and macromolecules for biomedical research. EPA closely regulates tritium releases in compliance with the Clean Air Act. In a recent letter to the County Superintendent of Schools, EPA states that: "…parents and teachers should be very confident that they and their children will be safe when visiting the Lawrence Hall of Science."

5. Why can't the lab have meetings about all of this with the schools?

Berkeley Lab has held meetings with several local schools and has provided materials about the tritium issue to local school districts. The Lab has also made presentations to local Boards of Education, including the Berkeley Unified School District and the Alameda County Board of Education. For a request to discuss this important issue, please contact the Lab's Community Relations Office at 510-486-4387.

6. I grew up here; if I was exposed to tritium, might I have passed something on to my kids?

When a pregnant woman or nursing mother is exposed to tritium, some tritium will be transferred to the fetus or a suckling infant. However, this amount would be a small fraction of the average tritium intake by the mother, which itself is minimal. The most recent estimates of the lifetime excess risk of cancer incidence due to single or multiple visits to the nearest locations at which exposure to tritium might occur show values so small that they would be indistinguishable from zero.

7. Why haven't any health surveys been done of the neighborhoods where the tritium may have gone- and where DID it go exactly?

See response to Question 2 in Past Releases section above. The ATSDR report concluded that there was "no apparent indication that the health of nearby residents is at risk from radiological releases from the Lawrence Berkeley National Laboratory and the National Tritium Labelling Facility." The entire ATSDR report is available for review at http://www.lbl.gov/LBL-Programs/tritium/index.html

8. Isn't the fog a means by which the tritium can bind and become even more deadly to humans? NTLF is in a fog belt.

Tritium exchanges with water hydrogen in the rainwater or in fog, and exists as tritiated water vapor (HTO). If rain or fog occurs, the amount of water or water vapor in the air is at a maximum – i.e., the water hydrogen is greater than if there were no fog. Therefore, for the same amount of tritium release, the tritium concentration in air during the time

that rain and fog are present will be lower than when rain and fog are absent (given similar conditions of wind speed and atmospheric stability). Because fog and rain increase the amount of water in the atmosphere, the concentration of HTO is reduced through dilution and thus exposure, dose, and risk should be reduced.

9. Isn't there an earthquake fault running right near the NTLF?

Yes. Berkeley Lab is located in a region of seismic activity. The seismically active Hayward Fault trends in a northwest-southeast direction along the base of the hills below the Lab.

However, an analysis of the tritium exposure, which could arise from a major event (such as an earthquake), has been conducted and documented in the NTLF's Safety Analysis Document. Because of the way the tritium is stored at the NTLF, the only release that could occur during an earthquake would be from tritium in use at the time the earthquake occurred – i.e., only a small fraction of the total inventory. Thus, even in an earthquake, the exposure to people in the area will remain extremely low.

10. Could the tritium releases be one of the reasons that the SF Bay Area has the highest rate in the country of breast cancer?

No. In human health studies where assessment of tritium exposure has been made so far, no evidence exists that low levels of tritium exposure will cause any detectable adverse health effects, including breast cancer. Also, please see the ATSDR report referenced above, at http://www.lbl.gov/LBL-Programs/tritium/index.html or at the UC Berkeley main library, Doe Library, second floor. The calculated excess lifetime risk of cancer incidence due to exposure to tritium (at a small fraction of one chance in one million) is extremely small compared to the actual background incidence that is presently reported for the San Francisco Bay Area. For example, the reported background incidence of breast cancer in the San Francisco Bay Area is slightly less than one chance in ten.

11. What else is released into the air or water from the tritium labeling facility? Is it just tritium or tritium byproducts, or what?

The NTLF is a typical biochemical research and development laboratory. It uses small quantities of many chemicals and materials that are commonly available and used in other laboratories on university campuses and at Berkeley Lab. Tritium is the only radioactive isotope used at the NTLF. Tritium releases are in the forms of tritiated water (HTO) and tritium gas (HT).

12. Why hasn't the lab done surveys of people who have lived in the tritium "downwind" regions over the past years to see if they have any health problems which may show patterns?

There is no reason to believe that tritium releases from the Berkeley Lab will result in detectable adverse effects in the residents around the Lab. Its emissions are far below the

regulatory standards. This belief is strengthened by a report from the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR). The ATSDR report has examined issues associated with a petition that included tritium releases from LBNL, possible cancer clusters, and infertility issues in the neighborhoods surrounding the facility. The ATSDR report has concluded that there was "no apparent indication that the health of nearby residents is at risk from radiological releases from the Lawrence Berkeley National Laboratory and the National Tritium Labelling Facility." For a review of the entire report, please see the website at: http://www.lbl.gov/LBL-Programs/tritium/index.html.

13. Have citizens, particularly parents, been involved in advising the sampling plans?

The Environmental Sampling Project Task Force has 21 members who represent a broad array of community stakeholders, including neighborhoods, public interest groups, advocacy groups, business and real estate interests, and regulators. Many of its members are parents and grandparents with children in the local schools. The public has also participated at Task Force meetings or may comment directly on the draft sampling plans via the Task Force website at: http://www.lbl.gov/ehs/tritium/.

14. Most of us, as parents, OUTSIDE Berkeley, but whose kids frequent the LHS, haven't been involved before in all of this- how can we become involved?

Please request that your name be added to the mailing list for public notification of task force meetings. Attend the task force meetings to follow the development of a sampling plan, and its results and analyses. You can read about the tritium issues, the task force and environmental monitoring programs at these web sites:

Tritium issues: http://www.lbl.gov/LBL-Programs/tritium/index.html.
Environmental Sampling Project Task Force: http://www.lbl.gov/ehs/tritium/.
Environmental Monitoring Programs:
http://www.lbl.gov/ehs/epg/html/env_protection.htm.

15. Can you advertise meetings ahead of time?

The Laboratory requests that local newspapers list task force meetings in their section on upcoming community events. Agenda notices are mailed to an established mailing list. If you would like to add your name to this list, please contact the Lab's Community Relations Office at 510-486-4387.

16. WHY should we parents have to accept regulatory exposure standards? What if we don't want our children exposed at all?

The regulatory agencies provide an appropriate standard of protection for humans without unduly limiting the beneficial practices giving rise to radiation exposure. This aim of providing an appropriate standard of protection cannot be achieved on the basis of scientific concepts alone. The regulatory agencies have the responsibility for

supplementing their scientific knowledge by value judgments about the relative importance of different kinds of risk and about the balancing of risks and benefits. The agencies take the position that the basis for such judgments should be made clear in order to communicate with various stakeholders, including the public, on how the decisions have been reached in formulating regulatory standards for the industry. The regulatory agencies base their recommendations on risk estimates derived from several credible sources.

The state of no exposure is not achievable in light of the radiation exposure we all receive from natural background radiation. For example, individuals living around the Bay Area are exposed to an average dose of about 100-400 millirem from a variety of natural background radiation sources. Tritium releases from the NTLF contribute less than 0.1% additional dose to the natural background doses to the most exposed (hypothetical) individual. For more realistic exposure conditions, the tritium dose is much lower than this. At such levels, the additional risk would be undetectable and could not be distinguished from zero.